WHAT IS CLAIMED IS:

1. An optical cross-connect apparatus for performing optical cross-connection of optical signals, the apparatus comprising:

an input optical signal processing section for converting wavelengths contained in each input WDM signal into wavelengths the number of which is equal to the number of WDM signals, for compressing the pulse widths of the WDM signals by dividing the pulse widths by the number of the wavelengths contained in each input WDM signal, and for performing a phase shift so that the phases of a plurality of compressed signal will not be the same;

a wavelength switching section including passive optical devices for distributing the optical signals processed by the input optical signal processing section according to wavelengths; and

an output optical signal processing section for converting wavelengths contained in the optical signals distributed by the wavelength switching section into wavelengths recognized from the phases of the optical signals, for expanding the pulse widths of the optical signals, and for outputting WDM signals.

2. The optical cross-connect apparatus according to claim 1, wherein switch size $n \times m \leq$ (optical fiber band) $\times$ (pulse width of input optical signal) $\times$ 0.5, where n is the number of the WDM input optical signals and is equal to the number

of wavelengths in the apparatus, and m is the number of the wavelengths contained in each WDM input optical signal and is equal to a time division number used for pulse width compression.

3. The optical cross-connect apparatus according to claim 1, wherein the wavelength switching section includes a demultiplexer for separating the optical signals according to wavelengths and a multiplexer for combining demultiplexed optical signals with the same wavelength.

4. The optical cross-connect apparatus according to claim 1, wherein the wavelength switching section includes a WDM coupler for collecting n optical signals, in the case of the number of the WDM input optical signals being n, and a demultiplexer for separating the collected optical signals according to wavelengths.

5. The optical cross-connect apparatus according to claim 1, wherein the input optical signal processing section includes:

a demultiplexer for separating the input WDM signals according to wavelengths;

a wavelength converter for converting wavelengths of the demultiplexed signals on the basis of a wavelength specification signal;

a pulse width compression section for compressing pulse widths of the wavelength-converted signals;

a variable delay for shifting phases of the compressed signals on the basis of a phase specification signal;

a multiplexer for combining the phase-shifted compressed signals; and

an input light conversion control section for setting the wavelength specification signal and for setting the phase specification signal on the basis of a signal outputted from the multiplexer.

6. The optical cross-connect apparatus according to claim 1, wherein the input optical signal processing section includes:

a demultiplexer for separating the input WDM signals according to wavelengths;

a control pulse generation section for generating control pulses with a variable wavelength on the basis of a wavelength specification signal and for outputting the control pulses in phases based on a phase specification signal;

a nonlinear loop mirror for accepting the demultiplexed optical signals and the control pulses and for outputting overlap portions of the demultiplexed optical signals with the control pulses;

a WDM coupler for combining the output from the nonlinear loop mirror; and

an input light conversion control section for setting the wavelength specification signal and for setting the phase specification signal on the basis of a signal outputted from

the WDM coupler.

7. The optical cross-connect apparatus according to claim 1, wherein the output optical signal processing section includes:

a chirp pulse light source for emitting chirp pulses with a wavelength which changes continuously with time;

a nonlinear loop mirror for accepting the optical signals outputted from the wavelength switching section and the chirp pulses and for outputting overlap portions of the chirp pulses with the optical signals outputted from the wavelength switching section; and

a wavelength dispersion slope control section for detecting wavelength dispersion values of a pulse with a shortest wavelength and a pulse with a longest wavelength selected from the output from the nonlinear loop mirror and for flattening a wavelength dispersion slope obtained from the detected wavelength dispersion values.

8. The optical cross-connect apparatus according to claim 1, wherein the output optical signal processing section includes:

a sequential switch for sequentially switching and outputting the optical signals outputted from the wavelength switching section;

a wavelength converter for converting wavelengths contained in the switched signals;

a pulse width expansion section for expanding pulse widths of the wavelength-converted signals; and

a multiplexer for combining the pulse-width-expanded signals.

9. The optical cross-connect apparatus according to claim 1, wherein the output optical signal processing section includes:

a sequential switch for sequentially switching and outputting the optical signals outputted from the wavelength switching section;

a wavelength converter for converting wavelengths contained in the switched signals;

a multiplexer for combining the wavelength-converted signals; and

a wavelength dispersion slope control section for detecting wavelength dispersion values of a pulse with a shortest wavelength and a pulse with a longest wavelength selected from the multiplexed signal and for flattening a wavelength dispersion slope obtained from the detected wavelength dispersion values.

10. An optical cross-connect apparatus for performing optical cross-connection of optical signals, the apparatus comprising:

a wavelength converter for converting wavelengths contained in each input WDM signal into wavelengths the number

of which is equal to the number of WDM signals;

a wavelength switching section including:

a demultiplexer for separating the wavelength-converted optical signals according to wavelengths;

a pulse width compression and phase shift section for compressing pulse widths of the demultiplexed optical signals by dividing the pulse widths by the number of the wavelengths contained in each input WDM signal and for performing a phase shift so that phases of a plurality of compressed signal will not be the same; and

a multiplexer for combining the phase-shifted optical signals, and

an output optical signal processing section for converting wavelengths contained in the optical signals distributed by the wavelength switching section into wavelengths recognized from phases of the optical signals, for expanding pulse widths of the optical signals, and for outputting WDM signals.

11. The optical cross-connect apparatus according to claim 10, wherein n which is the number of the WDM input optical signals and which is equal to the number of wavelengths in the apparatus and m which is the number of the wavelengths contained in each WDM input optical signal and which is equal to a time division number used for pulse width compression are set independently of each other.

12. An optical cross-connect apparatus for performing non-blocking optical cross-connection of WDM input optical signals, the number of which is n and each of which contains m wavelengths λ1 through λm, in the case of m > n, the apparatus comprising:

n wavelength converters for converting the wavelengths contained in the WDM input optical signals into wavelengths λ1 through λ2m;

a first wavelength switching section including:

n demultiplexers for separating the wavelength-converted optical signals according to wavelengths;

(2m x n) first optical signal processing sections for converting a wavelength contained in each of the demultiplexed optical signals into one of wavelengths λ1 through λn, for compressing the pulse widths of the demultiplexed optical signals by the use of the time division number 2m, and for performing a phase shift so that the phases of a plurality of compressed signals will not be the same; and

n multiplexers , to which output fibers of the first optical signal processing sections are connected by (2m/n)s, for combining the phase-shifted optical signals,

n first wavelength conversion and pulse width expansion sections for converting wavelengths contained in output from the first wavelength switching section into the wavelengths λ1 through λm and for performing pulse width expansion;

a second wavelength switching section including:

n demultiplexers for separating output from the first

wavelength conversion and pulse width expansion sections according to wavelengths;

(2m x n) second optical signal processing sections for converting a wavelength contained in each of the demultiplexed optical signals into one of wavelengths λ1 through λn, for compressing the pulse widths of the demultiplexed optical signals by the use of the time division number 2m, and for performing a phase shift so that the phases of a plurality of compressed signals will not be the same; and

n multiplexers , to which output fibers of the second optical signal processing sections are connected by (2m/n)s, for combining the phase-shifted optical signals, and

n second wavelength conversion and pulse width expansion sections for converting wavelengths contained in output from the second wavelength switching section into the wavelengths λ1 through λm and for performing pulse width expansion.

13. An optical cross-connect apparatus for performing non-blocking optical cross-connection of WDM input optical signals, the number of which is n and each of which contains m wavelengths λ1 through λm, in the case of m ≤ n, the apparatus comprising:

n wavelength converters for converting the wavelengths contained in the WDM input optical signals into wavelengths λ1 through λn;

a first wavelength switching section including:

n demultiplexers for separating the

wavelength-converted optical signals according to wavelengths;

(n x n) first optical signal processing sections for converting a wavelength contained in each of the demultiplexed optical signals into one of wavelengths λ1 through λn, for compressing the pulse widths of the demultiplexed optical signals by the use of the time division number 2m, and for performing a phase shift so that the phases of a plurality of compressed signals will not be the same; and

n multiplexers, to which output fibers of the first optical signal processing sections are connected on a one-to-one basis, for combining the phase-shifted optical signals,

n first wavelength conversion and pulse width expansion sections for converting wavelengths contained in output from the first wavelength switching section into the wavelengths λ1 through λm and for performing pulse width expansion;

a second wavelength switching section including:

n demultiplexers for separating output from the first wavelength conversion and pulse width expansion sections according to wavelengths;

(n x n) second optical signal processing sections for converting a wavelength contained in each of the demultiplexed optical signals into one of wavelengths λ1 through λn, for compressing the pulse widths of the demultiplexed optical signals by the use of the time division number 2m, and for performing a phase shift so that the phases of a plurality of compressed signals will not be the same; and

n multiplexers, to which output fibers of the second

optical signal processing sections are connected on a one-to-one basis, for combining the phase-shifted optical signals, and

n second wavelength conversion and pulse width expansion sections for converting wavelengths contained in output from the second wavelength switching section into the wavelengths λ1 through λm and for performing pulse width expansion.